ARTEKIT
ELECTRONIC ARTISTS
www.artekit.eu

AK-MACHX02-7000 Development Board

SCHEMATIC DIAGRAM REVISION 1.3

CONTENTS:

SHEET 1: COVER (This)
SHEET 2: BLOCK-DIAGRAM
SHEET 3: FPGA/DRAM/FLASH/DISPLAY
SHEET 4: JTAG/RS232/ETHERNET/GPIO
SHEET 5: VGA/KEYS/LED/JTAG-CONN

IN COLLABORATION WITH:

LATTICE SEMICONDUCTOR™

ARROW ELECTRONICS®

For more information: www.artekit.eu
NOTE: This board was designed and produced in Italy

Design Disclaimer

Artekit Italy ("ARTEKIT") provides this design as a service to our customers. Artekit has made a good faith attempt to build for the specifications provided or needed by the customer. Artekit provides this product "as is" and without "recourse" and MAKES NO WARRANTY, EXPRESSED, IMPLIED OR OTHERWISE, INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

SCHEMATIC DIAGRAM VERSION HISTORY

Nov-12-2012	1.0 - First version, not in production
Feb-20-2013	1.1 - Second version, some little changes - not in production
Mar-18-2013	1.2 - Change FLASH from S25FL064P0XMFI011 64Mb to AT25DF321A-SH-T 32Mb due to provider disponibility, in production
Jan-15-2016	1.3 Replace R4-4K7 by a 5pF capacitor, to avoid spurious clock pulses Replace DRAM MICRON MT48LC4M16A2P-75:P (obsolete) by the new P/N MICRON MT48LC4M16A2P-7E:J

BOARD VERSION HISTORY

Nov-29-2013	1.0 - Prototype, not in production
Apr-12-2013	1.1 - In production

CE RoHS COMPLIANT 2002/95/EC Pb

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Data: 16/01/2016	Product Name: AK-MACHX02-7000		
Sheet name: COVER			
Product code: AK-MACHX02-7000	Circuit:	Sheet: 1 of 5	Scale: 1/1
Designer: RUBEN H. MELECA	Rel. Date: May-10-2013	Control:	

AK-MACHX02-7000 BOARD BLOCK DIAGRAM

OPTIONAL TFT DISPLAY 480 X 272
MODULE CONNECTOR

ARTEKIT
AK-TFT480272

VGA CONNECTOR
12 BITS R2R SYSTEM

OPTIONAL microSD FILE SYSTEM
MODULE CONNECTOR

ARTEKIT
AK-SDFS-UART

INTERNAL 3.3V 800mA LDO
ST MICROELECTRONICS LD1117-33

FT2232D BASED LATTICE USB JTAG

EXTERNAL JTAG CONNECTOR

MACHX02-7000 QFP144

LATTICE
LCMX02-7000C-6TG144C

8MB SDRAM 16 BIT DATA BUS

MICRON
MT48LC4M16A2P-75

32Mb (4MB) SERIAL FLASH

ATMEL
AT25DF321A-SH-T

10/100 Mb ETHERNET

MICREL
KSZ8041NL

DB9-F RS232 CONNECTOR

3 USER KEYS + 1 DEDICATE KEY

4 USER LEDS + 1 POWER LED

21 USER GPIO

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Data: 16/01/2016	Product Name: AK-MACHX02-7000		
Sheet name: BLOCK-DIAGRAM			
Product code: AK-MACHX02-7000	Circuit:	Sheet: 2 of 5	Scale: 1/1
Designer: RUBEN H. MELECA	Rel. Date: May-10-2013	Control:	

FPGA

U1-B
LCMC02-7000C-6TG144C
BANK-0

PT36D/DONE	109	TFT_RED_0
PT36C/INITN	110	TFT_RED_1
PT35B	111	TFT_RED_2
PT35A	112	TFT_RED_3
PT33B	113	TFT_RED_4
PT33A	114	TFT_RED_5
PT28B	115	TFT_GREEN_0
PT28A	117	TFT_GREEN_1
PT27D/PROGRAMN	119	SN
PT27C/JTAGENB	120	TFT_GREEN_3
PT25B	121	TFT_GREEN_4
PT25A	122	TFT_GREEN_5
PT22D/SDA/PCLKC0_0	125	GPIO2
PT22C/SCL/PCLKT0_0	126	GPIO3
PT18B/PCLKC0_1	127	TFT_DE
PT18A/PCLKT0_1	128	TFT_CLK
PT17D/TMS	130	JTAG_TMS
PT17C/TCK	131	JTAG_TCK
PT15B	132	TFT_PWM
PT15A	133	GPIO1
PT14D/TDI	136	JTAG_TDI
PT14C/TDO	137	JTAG_TDO
PT11B	138	TFT_BLUE_0
PT11A	139	TFT_BLUE_1
PT10B	140	TFT_BLUE_2
PT10A	141	TFT_BLUE_3
PT9B	142	TFT_BLUE_4
PT9A	143	TFT_BLUE_5
VCCIO-B0.1	118	
VCCIO-B0.2	123	
VCCIO-B0.3	135	

+3.3V
R6 4K7
R24 4K7
C15 100nF
C16 100nF
C17 100nF

U1-A
LCMC02-7000C-6TG144C
BANK-1

PR24B/DQ1	73	DRAM_CS
PR24A/DQ1	74	DRAM_BA0
PR23B/DQ1	75	DRAM_BA1
PR23A/DQ1	76	DRAM_A10
PR21B/DQ1	77	DRAM_A0
PR21A/DQ1	78	DRAM_A1
PR18B/DQ1	81	DRAM_A2
PR18A/DQ1	82	DRAM_A3
PR17B/DQ1	83	DRAM_DQ13
PR17A/DQ1	84	DRAM_DQ14
PR16B/DQS1N	85	DRAM_DQ15
PR16A/DQS1	86	DRAM_DQ12
PR15B	87	TFT_HSYNC
PR15A	89	TFT_VSYNC
PR12B/PCLKC1_0/DQ0	91	DRAM_DQ11
PR12A/PCLKT1_0/DQ0	92	DRAM_DQ10
PR11B/DQS0N	93	DRAM_DQ9
PR11A/DQS0	94	DRAM_DQ8
PR9B/DQ0	95	DRAM_DQMH
PR9A/DQ0	96	DRAM_CLK
PR7B/DQ0	97	DRAM_CKE
PR7A/DQ0	98	DRAM_A11
PR5B/DQ0	99	DRAM_A9
PR5A/DQ0	100	DRAM_A8
PR4C	103	GPIO4
PR3B/R_GPLLC_IN/DQ0	104	DRAM_A7
PR3A/R_GPLLT_IN/DQ0	105	DRAM_A6
PR2B/R_GPLLC_FB/DQ0	106	DRAM_A5
PR2A/R_GPLLT_FB/DQ0	107	DRAM_A4
VCCIO-B1.1	79	
VCCIO-B1.2	88	
VCCIO-B1,3	102	

+3.3V
C12 100nF
C13 100nF
C14 100nF

U1-C
LCMC02-7000C-6TG144C
BANK-2

PB4A	38	AKUART_TX
PB4B	39	AKUART_RX
PB6A/CSSPIN	40	SPI_CS
PB6B	41	AKRESET
PB9A	42	TFT_GREEN_2
PB9B	43	GPIO5
PB12A/MCLK/CCLK	44	SPI_CLK
PB12B/SO/SPISO	45	SPI_MISO
PB13A	47	TS_CLK
PB13B	48	TS_CS
PB16A/PCLKT2_0	49	TS_MOSI
PB16B/PCLKC2_0	50	TS_MISO
PB18A	52	GPIO6
PB18B	54	GPIO7
PB23A/PCLKT2_1	55	GPIO8
PB23B/PCLKC2_1	56	DRAM_DQ5
PB26A	57	DRAM_DQ4
PB26B	58	DRAM_DQ3
PB29A	59	DRAM_DQ2
PB29B	60	DRAM_DQ1
PB31A	61	DRAM_DQ0
PB31B	62	DRAM_DQ6
PB31D	63	DRAM_RAS
PB35A	65	DRAM_DQ7
PB35B	67	DRAM_DQML
PB37A	68	DRAM_WE
PB37B	69	DRAM_CAS
PB38A/SN	70	SW_OPTION
PB38B/SI/SISPI	71	SPI_MOSI
VCCIO-B2.1	37	
VCCIO-B2.2	51	
VCCIO-B2.3	66	

+3.3V
C9 100nF
C10 100nF
C11 100nF

J13
PROGRAM
R30 10K SW_OPTION

U1-D
LCMC02-7000C-6TG144C
BANK-3

PL19A	25	GPIO11
PL19B	26	GPIO20
PL22A/PCLKT3_0	27	GPIO19
PL22B/PCLKC3_0	28	GPIO12
PL23D	31	GPIO13
PL24A	32	GPIO14
PL24B	33	GPIO15
PL25A	34	GPIO16
PL25B	35	GPIO17
VCCIO-B3.1	30	

C18 100nF

U1-E
LCMC02-7000C-6TG144C
BANK-4

PL10A	13	RMII_MDIO
PL10B	14	RMII_MDC
PL11A	15	RMII_RXD0
PL11B	17	RMII_RXD1
PL12A/PCLKT4_0	19	RMII_CRSDV
PL12B/PCLKC4_0	20	RMII_RX_ER
PL15A	21	RMII_TXD0
PL15B	22	RMII_TXD1
PL17A	23	RMII_TXEN
PL17B	24	ETH_INTN
VCCIO-B4.1	16	

C19 100nF

U1-F
LCMC02-7000C-6TG144C
BANK-5

PL3A/L_GPLLT_FB	1	GPIO18
PL3B/L_GPLLC_FB	2	GPIO10
PL4A/L_GPLLT_IN	3	FPGA_CLOCK
PL4B/L_GPLLC_IN	4	GPIO9
PL6A/PCLKT5_0	5	GPIO21
PL6B/PCLKC5_0	6	TFT_POWER
PL8A	9	UART_TX
PL8B	10	UART_RX
PL9A	11	ETH_RESET_OUT
PL9B	12	ETH_50MHZ
VCCIO-B5.1	7	

C20 100nF

U1-G
LCMC02-7000C-6TG144C
POWER

VCC1	36	
VCC2	72	
VCC3	108	
VCC4	144	
NC	129	
GND1	8	
GND2	18	
GND3	29	
GND4	46	
GND5	53	
GND6	64	
GND7	80	
GND8	90	
GND9	101	
GND10	116	
GND11	124	
GND12	134	

C21 100nF
C22 100nF
C23 100nF
C24 100nF
C25 10uF

U9
EN VDD
GND OUT
C53 100nF
10E R33 FPGA_CLOCK

+5V
J2

TFT_PWM	1	2	
TS_MISO	3	4	
TS_MOSI	5	6	
TS_CLK	7	8	TFT_POWER
TFT_VSYNC	9	10	TS_CS
TFT_CLK	11	12	TFT_DE
TFT_BLUE_4	13	14	TFT_HSYNC
TFT_BLUE_2	15	16	TFT_BLUE_5
TFT_BLUE_0	17	18	TFT_BLUE_3
	19	20	TFT_BLUE_1
TFT_GREEN_4	21	22	
TFT_GREEN_2	23	24	TFT_GREEN_5
TFT_GREEN_0	25	26	TFT_GREEN_3
	27	28	TFT_GREEN_1
TFT_RED_4	29	30	
TFT_RED_2	31	32	TFT_RED_5
TFT_RED_0	33	34	TFT_RED_3
	35	36	TFT_RED_1
	37	38	
	39	40	

DISPLAY

SDRAM

+3.3V
C5 100nF
C6 100nF
C7 100nF
C8 10uF
C1 100nF
C2 100nF
C3 100nF

U2
MT48LC4M16A2P-75

DRAM_A0	23	A0	
DRAM_A1	24	A1	
DRAM_A2	25	A2	
DRAM_A3	26	A3	
DRAM_A4	29	A4	
DRAM_A5	30	A5	
DRAM_A6	31	A6	
DRAM_A7	32	A7	
DRAM_A8	33	A8	
DRAM_A9	34	A9	
DRAM_A10	22	A10	
DRAM_A11	35	A11	
DRAM_WE	16	WE	
DRAM_CS	19	CS	
DRAM_CAS	17	CAS	
DRAM_RAS	18	RAS	
DRAM_DQML	15	DQML	
DRAM_DQMH	39	DQMH	
	6	VSS	
	12	VSS	
	28	VSS	
	41	VSS	
	46	VSS	
	52	VSS	
	54	VSS	
	2	DQ0	DRAM_DQ0
	4	DQ1	DRAM_DQ1
	5	DQ2	DRAM_DQ2
	7	DQ3	DRAM_DQ3
	8	DQ4	DRAM_DQ4
	10	DQ5	DRAM_DQ5
	11	DQ6	DRAM_DQ6
	13	DQ7	DRAM_DQ7
	42	DQ8	DRAM_DQ8
	44	DQ9	DRAM_DQ9
	45	DQ10	DRAM_DQ10
	47	DQ11	DRAM_DQ11
	48	DQ12	DRAM_DQ12
	50	DQ13	DRAM_DQ13
	51	DQ14	DRAM_DQ14
	53	DQ15	DRAM_DQ15
	37	CKE	DRAM_CKE
	38	CLK	DRAM_CLK
	20	BA0	DRAM_BA0
	21	BA1	DRAM_BA1
	1	VDD	
	3	VDD	
	9	VDD	
	14	VDD	
	27	VDD	
	43	VDD	
	49	VDD	

R1 22E

SERIAL FLASH

+3.3V
C27 100nF
C26 10uF
R2 10K
U3
AT25DF321A-SH-T

	7	HOLD	
	8	VCC	
SPI_CS	1	CS	
SPI_MISO	2	SO/IO1	
	6	SCK	SPI_CLK
	5	SI/IO0	SPI_MOSI
	4	VSS	
	3	W/ACC/IO2	

R3 10K
R5 0E
C51 5pF
Ex R4 (4K7)

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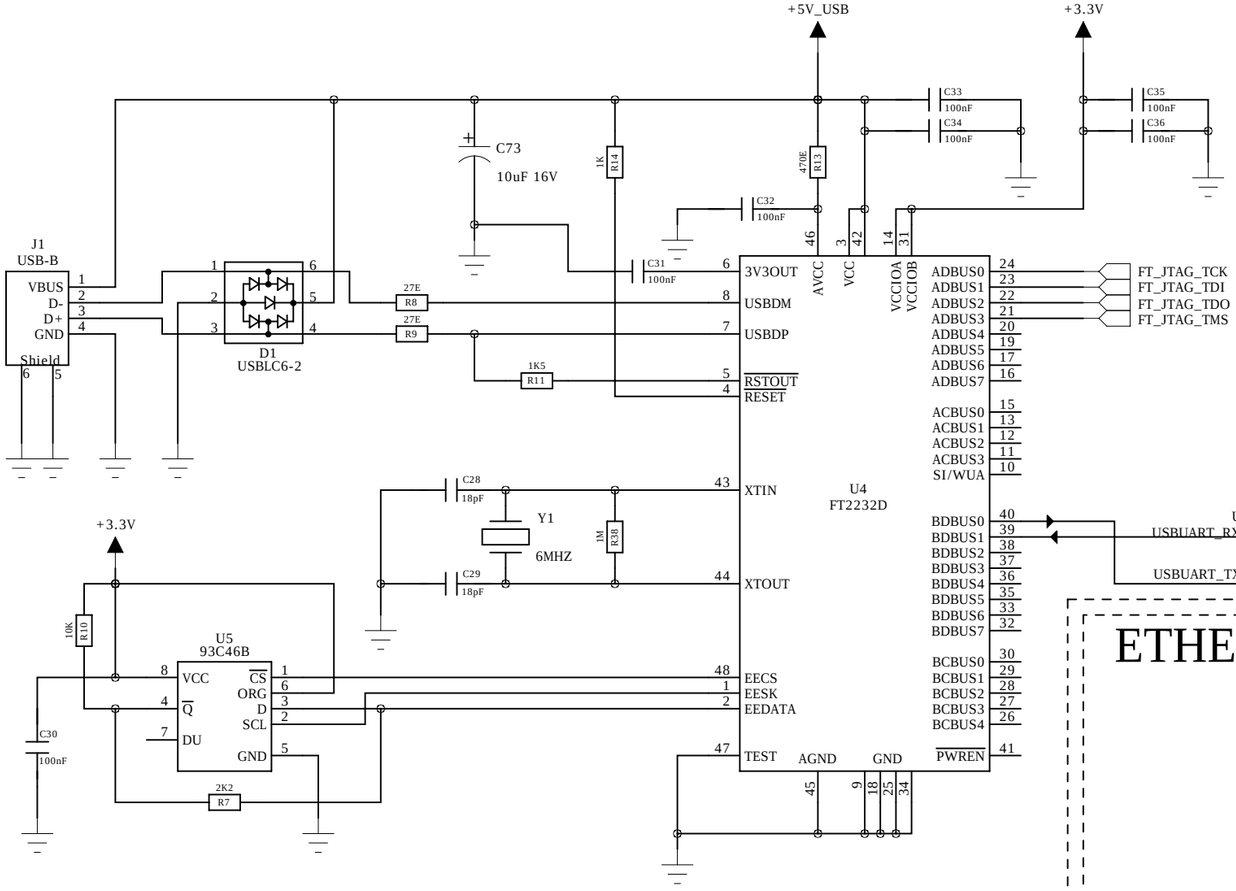
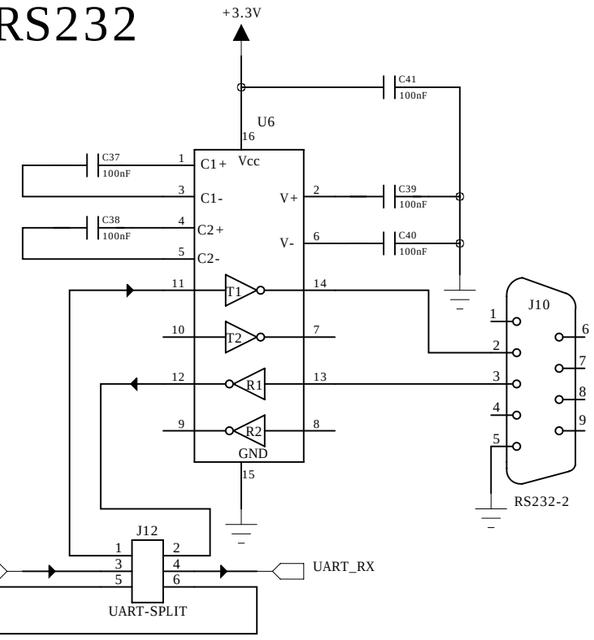
Date: 16/01/2016	Product Name: AK-MACHX02-7000		
Sheet name: FPGA/DRAM/FLASH/DISPLAY			
Product code: AK-MACHX02-7000	Circuit:	Sheet: 3 of 5	Scale: 1/1
Designer: RUBEN H. MELECA	Rel. Date: May-10-2013	Control:	

JTAG-UART

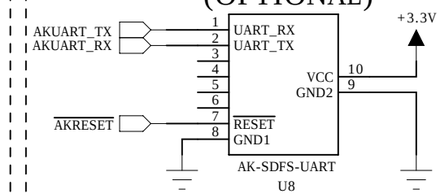


RS232

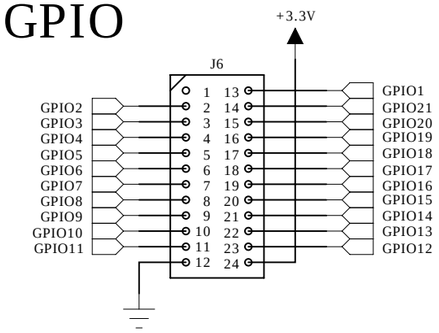


AK-SDFS-UART

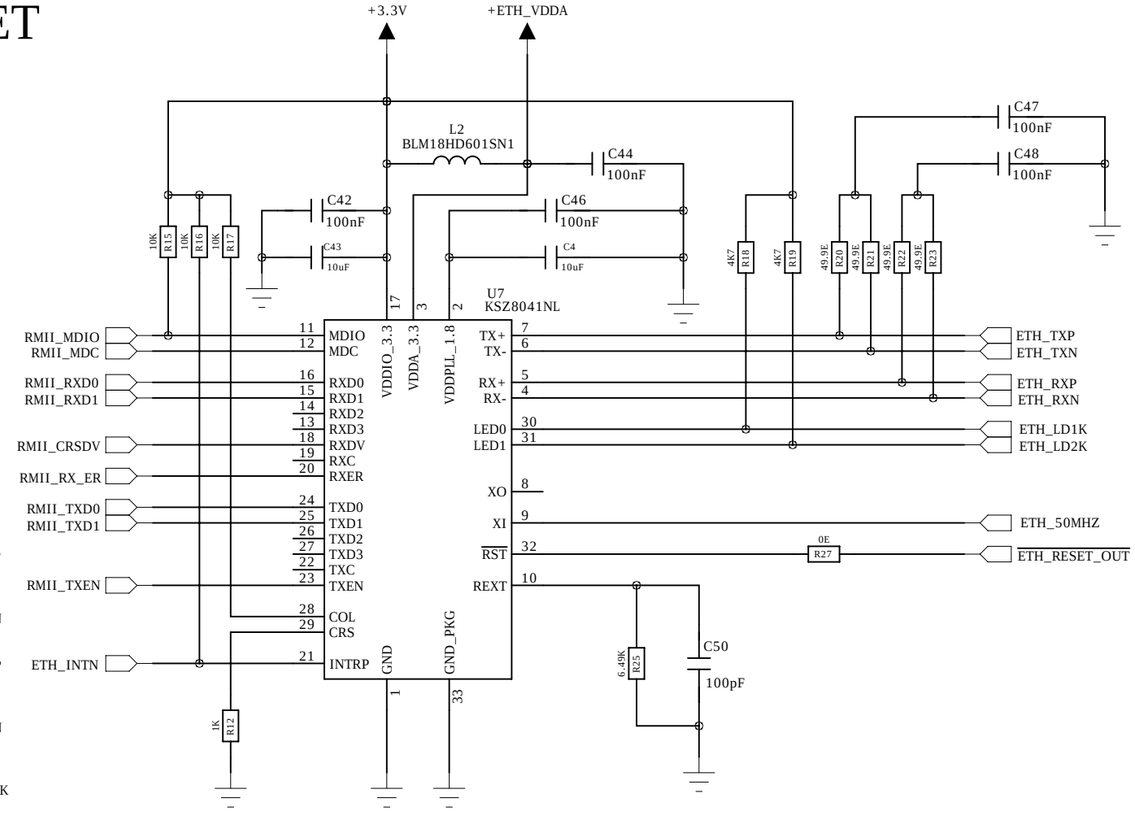
(OPTIONAL)



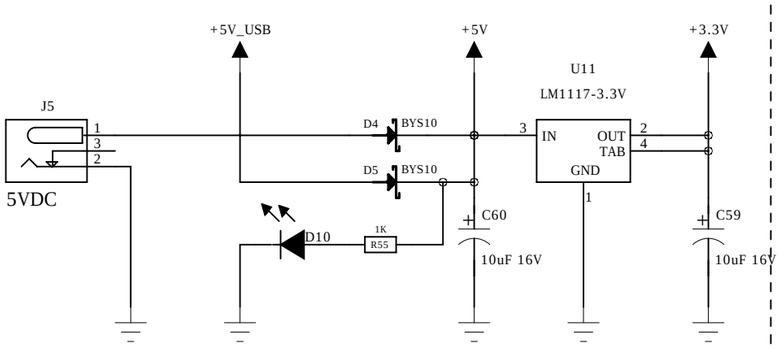
GPIO

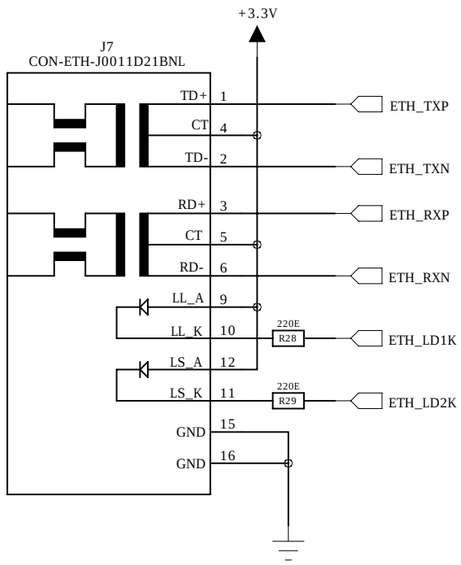


ETHERNET



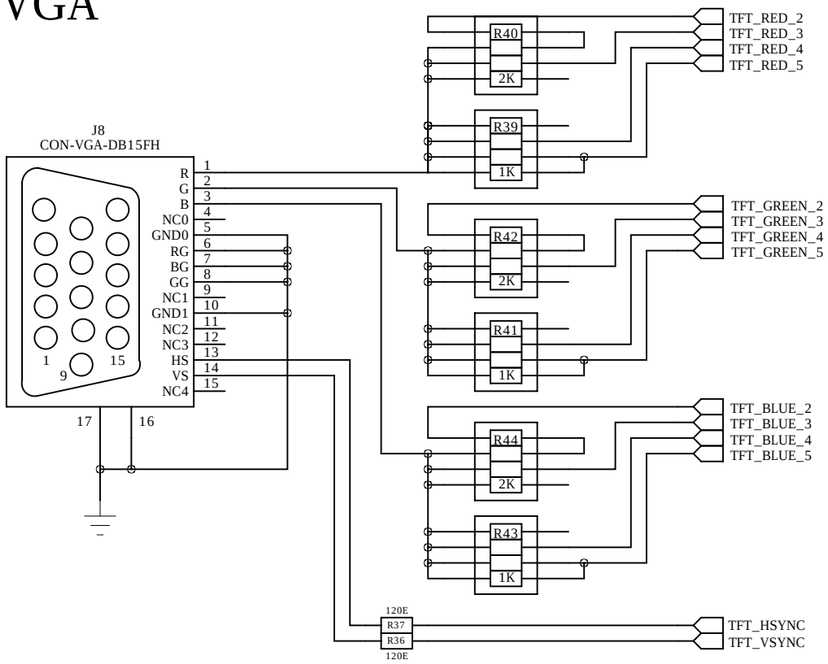
POWER



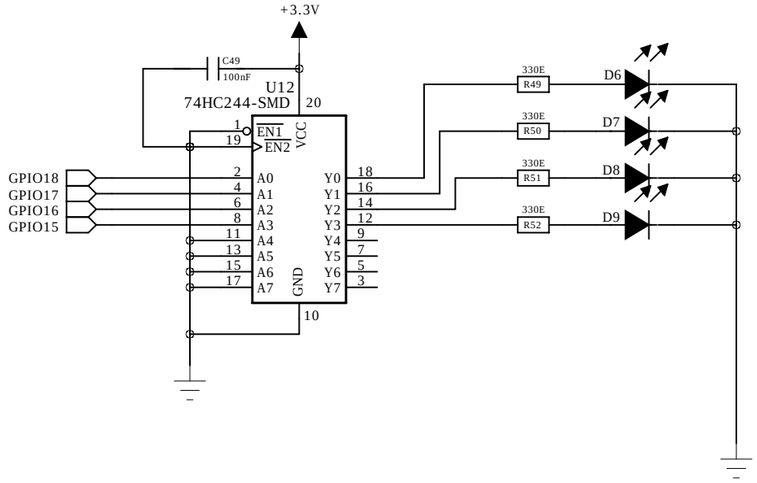


This design is property of ARTEKIT Italy and NOT constitute a reference design	Data: 16/01/2016	Product Name: **AK-MACHX02-7000**	
	Sheet name: JTAG/RS232/ETHERNET/GPIO		
	Product code: AK-MACHX02-7000	Circuit:	Sheet: 4 of 5 / Scale: 1/1
	Designer: RUBEN H. MELECA	Rel. Date: May-10-2013	Control:

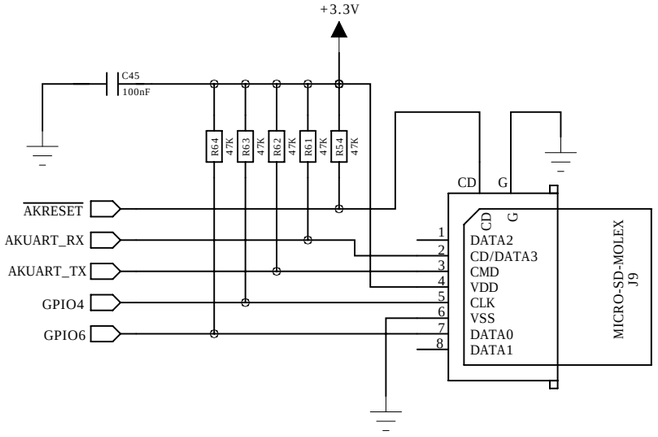
VGA



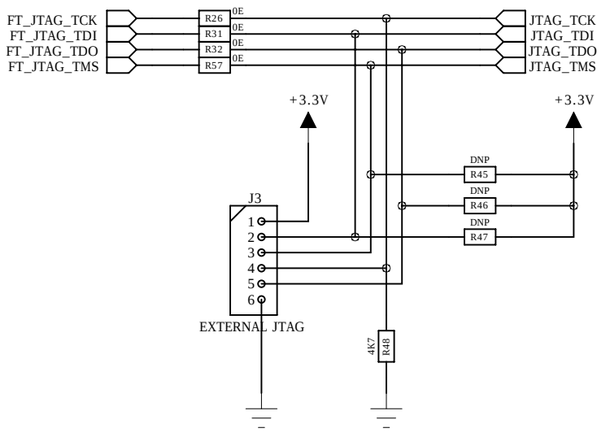
USER LED



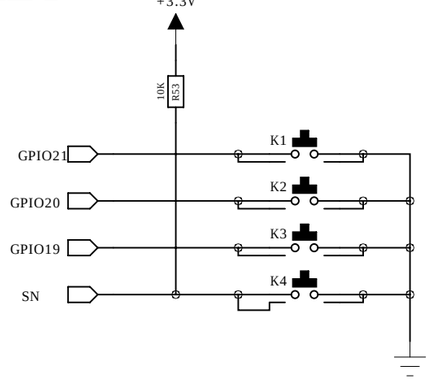
MICRO-SD



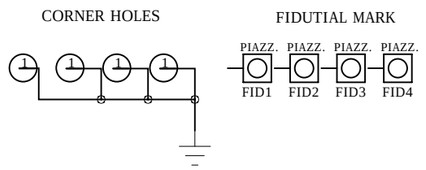
JTAG EXTERNAL CONNECTOR



USER KEY



MECHANICAL



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Data: 16/01/2016	Product Name: **AK-MACHX02-7000**		
Sheet name: VGA/KEYS/LED/JTAG-CONN			
Product code: AK-MACHX02-7000	Circuit:	Sheet: 5 of 5	Scale: 1/1
Designer: RUBEN H. MELECA	Rel. Date: May-10-2013	Control:	